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13. ABSTRACT *(Maximum 200 words)*

The ultimate goal of this program was to use spatial solitons as reconfigurable interconnects for guiding signals between multiple input and output ports. the central idea is to use the solitons as a waveguide for guiding signals. Deflecting the soliton electro-optically allows the soliton (and hence the signal) to be steered in space. The research goals were to:

1. Steer solitons electro-optically in AlGaAs slab waveguides;
2. Grow PTS crystals in bulk and waveguide from and guide solitons in them;
3. Understand some of the basic properties of spatial solitons in quadratic media. And assess their suitability for inteconnects.
4. Implement rudimentary interconnects and assess performance.

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Project Title: Reconfigurable Network Routing with Spatial Soliton Crossbar Switches

Grant No.: F49620-96-1-0419

Final Report: July 1, 1996 - December 31, 1998

Principal Investigator: George I. Stegeman, CREOL, Un. Central Florida

Personnel: Professor George Stegeman (Faculty in School of Optics and CREOL, Cobb Family Chair); Dr. Michael Canva (Visiting Professor); Russell Fuerst (Graduate Student); Roman Malendevich (Graduate Student); Lars Friedrich (Graduate Student); Dr. Roland Schiek (Visiting Scientist); Dr. Masa Okhawa (Visiting Scientist); Yongsoon Baek, (Graduate Student, PhD 1997)

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Research Achievements:

1. Material Systems Available

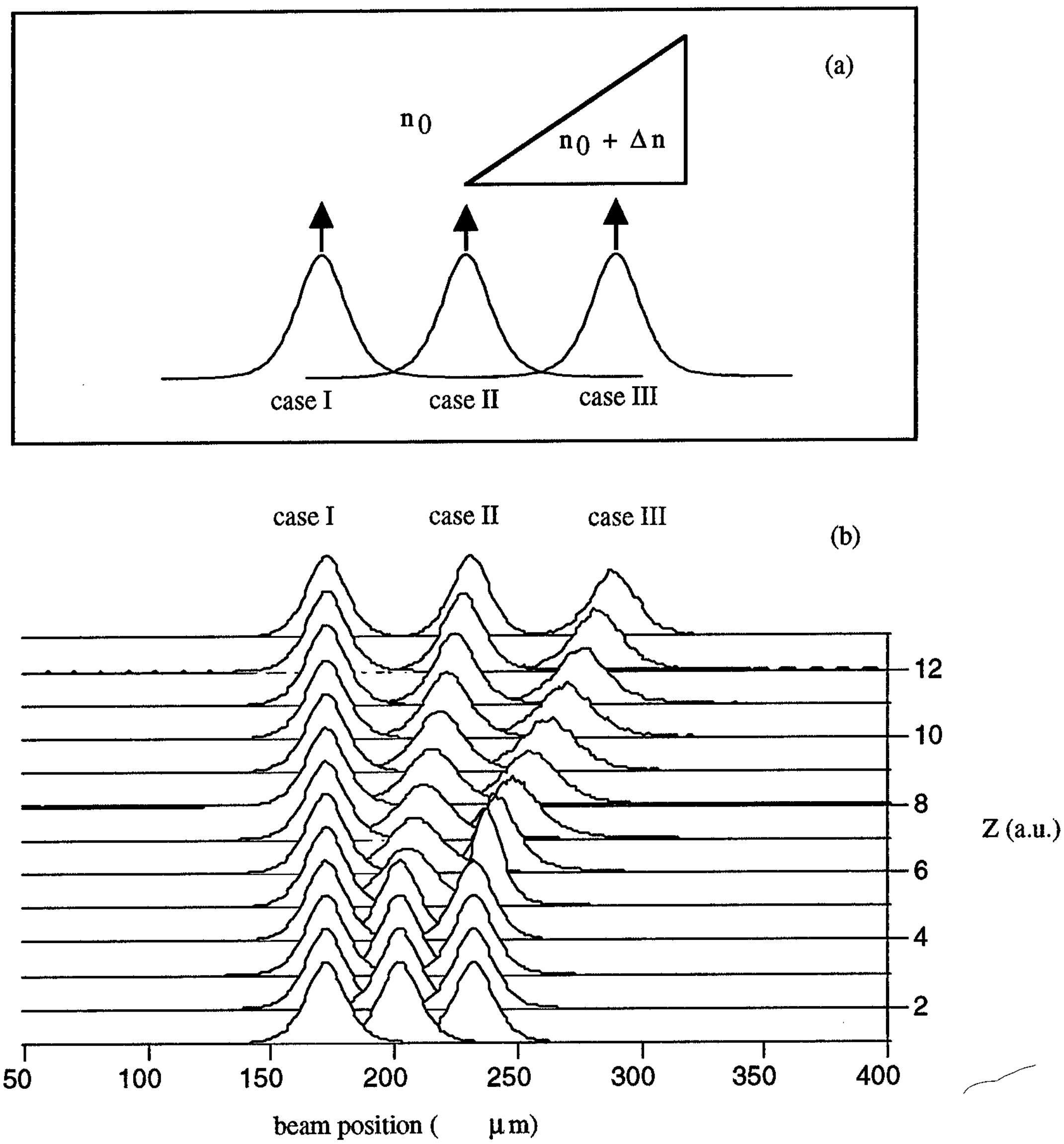
Research was performed on spatial solitons in three material systems. At the outset, spatial solitons had already been studied in AlGaAs with the Al/Ga ratio adjusted to so that one-half the semiconductor bandgap was just below 1.5μm. Using photons of wavelength just above half of the bandgap, "classical" spatial solitons had been excited in slab waveguides. This program continued on from this point.

At the outset of the program, spatial solitons had just been discovered experimentally in media used for frequency doubling. The properties of these "quadratic" solitons were essentially unknown and were investigated in this program with the focus on interconnect relevant features.

Also at the outset of this program, the large nonlinearities in single crystals of the conjugated polymer PTS had just been measured and its potential for spatial solitons for 2D interconnects had been quantified. Research into solitons in PTS was initiated.

2. Research Results in AlGaAs

A key assumption in our approach to reconfigurable interconnects was that a soliton beam would be refracted on propagation through an interface between two guiding media with different refractive indices. We investigated the propagation of spatial solitons through a triangular pad fabricated on a slab waveguide surface of the shape needed for electro-optical control of the soliton propagation direction, i.e. to reconfigure an interconnect. In this case the pads had a different refractive index from the surrounding waveguide and were configured to refract the soliton into a new direction. That is, the pad acted like a prism. The geometry and the directions



of the soliton beams launched are shown in Fig. 2.1a. Numerical simulations of the propagation of the solitons are shown in Fig. 2.1b. The soliton beam was deflected with minimal loss (< 1dB).

Figure 2.1 (a) Schematic of the launching conditions relative to the wedge. (b) Numerical simulations showing the propagation of solitons for the launching conditions shown in (a).

Output beam profiles are shown in Fig. 2.2 for the different cases. When the beam intersected the corners of the pad, the deflection angle was reduced by the fraction of the beam energy which did not propagate through the pad, as expected. Only for propagation along one edge of the pad, a geometry that we did not expect to encounter for interconnects, was significant scattering loss encountered.

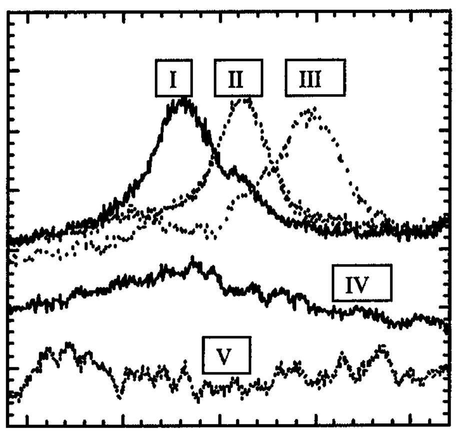


Figure 2.2 Experimental results showing the output beam profiles for the different launching cases shown in Figure 2.1a. Case IV is for the same launching condition as case II, but for a weak non-soliton beam and V is for Case IV launched at the prism corner.

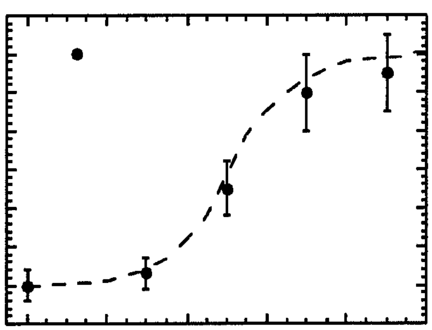
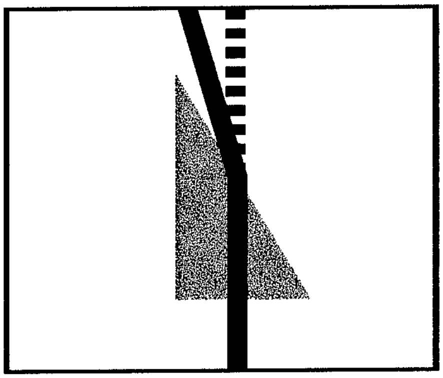


Figure 2.3 Lateral shift of the beam relative to the input beam position as a function of spatial overlap between the soliton beam and the linear wedge. Solid dots and the dotted line represent the experimental and theoretical results, respectively.

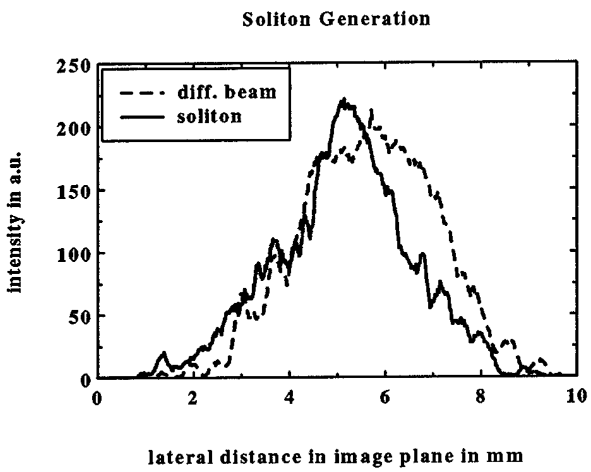
We have succeeded in deflecting spatial solitons, and the orthogonally polarized signal beam guided by them as shown in Figure 2.4 (LHS). It was implemented in AlGaAs slab waveguides into which a prism was fabricated. The upper cladding was, except for a 0.5 μm layer directly adjacent to the core, p-doped, whereas the lower cladding layer was n-doped (again with



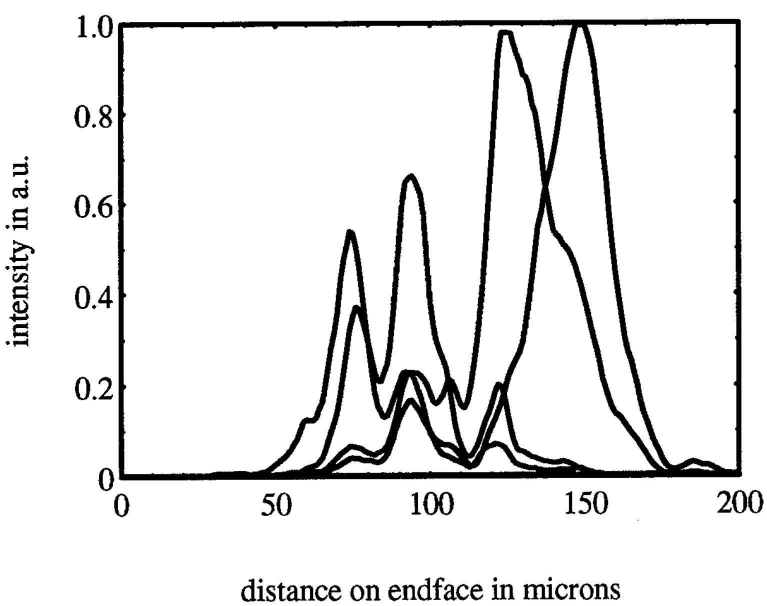
the exception of the 0.5μm next to the core). The waveguide core was undoped. Thus the device was used as a diode in the direction perpendicular to the waveguiding film. On top of the

Figure 2.4. The geometry of the triangular pad used for deflecting spatial solitons.

device a heavily p-doped layer of 0.1μm thickness was formed and photolithographically processed so that only wedge-shaped regions (i.e. prisms) of it remained. These served then as the top electrodes and the substrate formed the bottom electrode. By contacting these electrodes and injecting carriers in the forward-bias regime of the above mentioned diode, the index of the AlGaAs was lowered, thus creating a (low index) prism in the material.

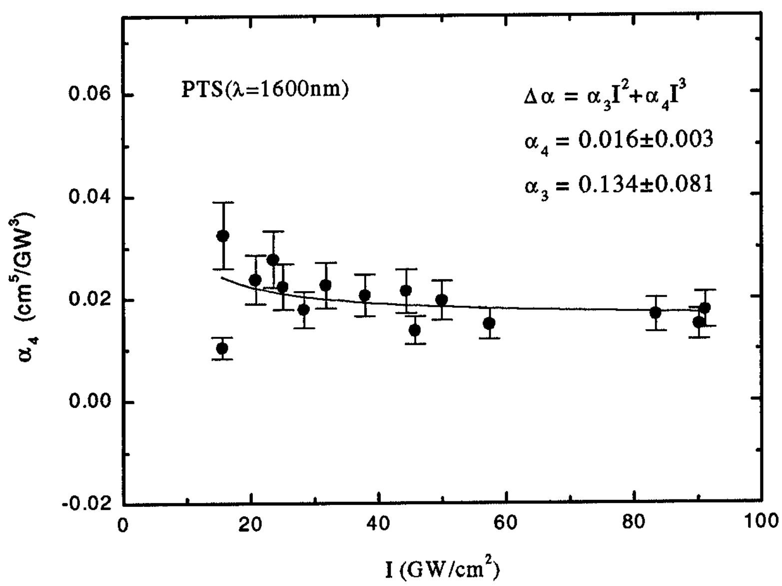


Shown to the left are the spatial profiles of the signal beam guided by the soliton. Without the soliton beam present the signal beam diffracts to ~3 times the width shown below. The output width of the signal beam is essentially identical to that of the soliton, a consequence of a cross-phase modulation of unity in this material. When current is applied to the prism region, the resulting charge injection modifies the refractive index and the soliton and signal are deflected by the prism. The result is shown below. This is essential a soliton controlled 1 ➔ 2 dynamic interconnect.



Further experiments were performed to increase the deflection, and hence increase the number of output channels. Shown to the left is a 1 ➔ 4 interconnect. There were two scratches on the output facet and they caused the two sets of spurious peaks seen in the results. The decrease in the height of the guided signals is due to free carrier absorption created by the charges injected under the electrode.

It has recently been reported that spatial solitons can bifurcate under certain conditions. This is not only fascinating physics, but also could affect our soliton interconnect scheme. Initial experiments indicate that the bifurcation does occur.



3. PTS

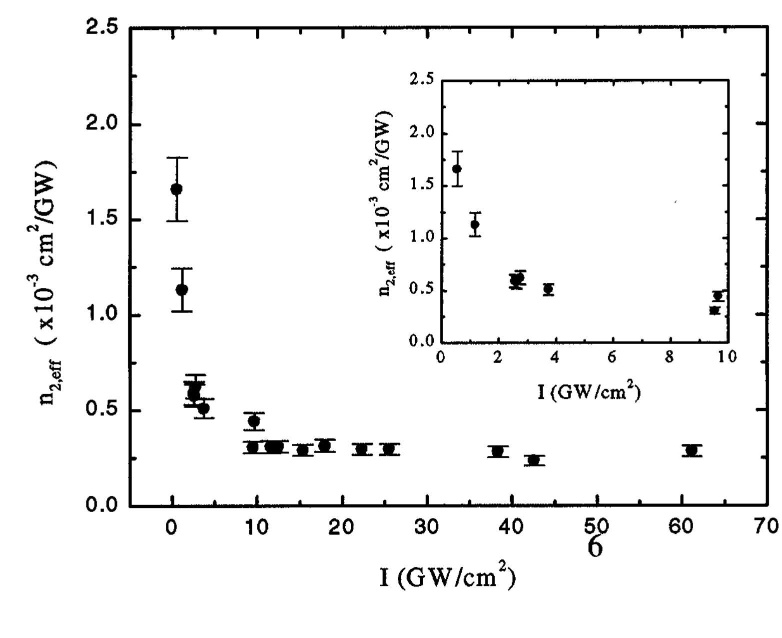
We have succeeded in synthesizing, growing and polymerizing large single crystals of largely defect-free PTS. There were two key pieces of technology. The first was very slow crystal growth from solution, 40-60 days for a single batch of crystals. The second important procedure was controlled polymerization. Unless carefully controlled, thermal polymerization leads to a run-away process. By careful thermal control, the rapid polymerization was slowed down from minutes to many hours and the stress was allowed to relax.

This material is ideal for soliton interconnects because it exhibits the largest known non-resonant nonlinearity known to date at the communications wavelength of 1.55 μm. A visitor was asked to characterize this material at 1.6 μm with 100 fsec pulses to verify that it gave the same nonlinearity n_2 as was measured previously with 20 psec pulses in samples grown by Greg Baker of Michigan State University. The same value was measured up to 10 GW/cm^2. However, at higher intensities massive four photon absorption (4PA) was measured ($\Delta\alpha = \alpha^4 I^3$) , as shown above in Figure 3.1. In general 4PA has not been observed before except in semiconductors where free carrier scattering participated in a sequential process. (Note that three photon absorption may also play a role as indicated by the small rise in the effective α^4 at low intensities.) Further experiments at 1.9 μm have exhibited an increase in the 4PA coefficient by a factor of 15! Examination of the known electronic states indicates that this is due to the resonant enhancement of the 4PA by three photon absorption, an effect which has not been observed previously. Fortunately this massive nonlinear absorption occurs at intensities higher than those needed for soliton interconnects.

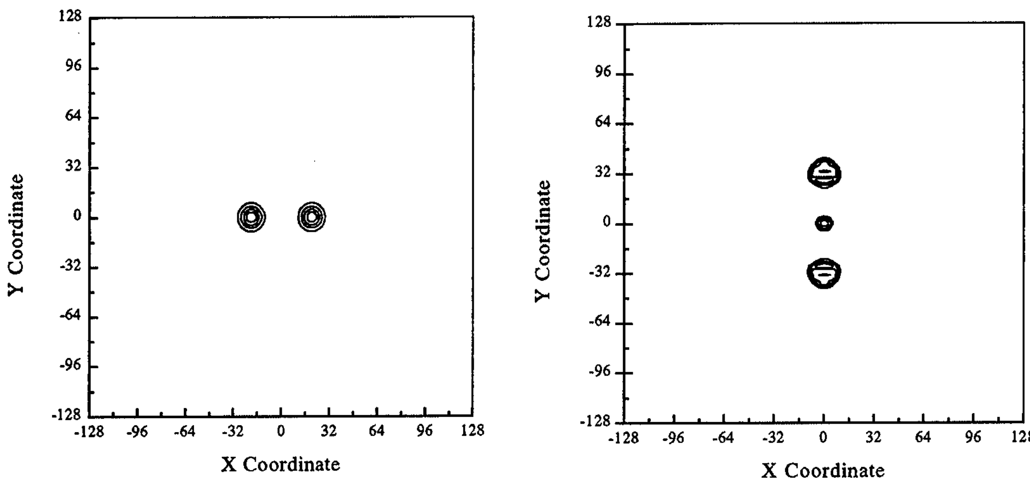
The dispersion of the effective n_2 with increasing intensity has proven equally interesting. It was measured by Z-scan and the results are shown in the Figure 3.2 above (preceding page). Clearly the variation in $\Delta n(I)$ cannot be described by n_2 and there are multiple processes involved. The final interpretation will be interesting!

The interesting properties of PTS offer the exciting possibility to use soliton collisions for extending the interconnects into two dimensions. Above we show (Figure 3.3) the results of numerical modeling of a collision in which the output solitons (upper right) are deflected out of the incidence plane (upper left) of the input solitons. (The incidence plane is the x-z plane and the pictures are cuts in the y-x plane before (left) and after (right) the collision.) This type of interaction could prove useful in extending the interconnects into a second dimension, i.e. for a NxN $\rightarrow$ NxN.

Two dimensional (2D) spatial solitons were propagated in the bulk PTS crystals. The unique behavior by which a higher order nonlinearity $n_3 < 0$ exists ($\Delta n = n_2 I + n_3 I^2$) allows spatial solitons to be self-guided in this material. The evolution of the beam output from the crystal is shown below in Fig. 3.4. Note the formation of the solitons for a peak intensity of a few GW/cm^2. However, there is a direct repurcussion to the existence of a large negative n_3, that is there is a limited range of intensities for which the soliton can exist. At higher intensities the stable soliton is sourrounded by a ring, as seen in Fig. 3.5. In fact, this result is in excellent agreement with the numerical simulations.



We have also grown 6 micron thick films of PTS between two glass plates. 1.5μm radiation has been guided in this multimode film and the stray scattering was reasonable for a first attempt. This work is continuing.



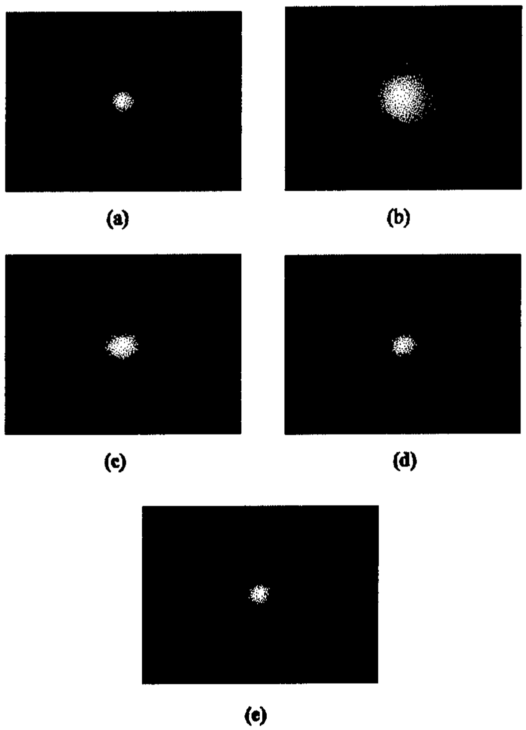


Figure 4

Fig. 3.5 The output beam observed at the output face of the crystal for an input intensity of 5 GW/cm^2

Fig. 3.4 (a) The input beam; (b) low power diffracted outputbeam; (c) 0.12 GW/cm^2; (d) 0.65 GW/cm^2; (e) 1.5 GW/cm^2

4. <u>Quadratic Solitons</u>

A number of experiments were performed on the new phenomenon of quadratic solitons both in bulk media and in waveguides in order to understand whether their properties were useful for interconnects. First we describe experiments in a bulk crystals.

(a) A new family of bulk quadratic solitons has been discovered in Type II phase-matched interactions. Solitons with different ratios (from those obtained in SHG) of the second harmonic, the o-polarized fundamental and the e-polarized fundamental were observed. In fact, these ratios can be tuned continuously by changing the input polarization. *The key result is that a quadratic soliton can be launched with primarily one fundamental polarization.* This means that a soliton can be formed with a strong pump beam and a weak signal beam, and that the weak signal beam can be guided by the strong pump beam as a quadratic soliton. The direction of the strong pump can in principle be controlled electro-optically because the materials which support quadratic solitons are also electro-optic active. *This is clearly of interest to reconfigurable interconnects.*

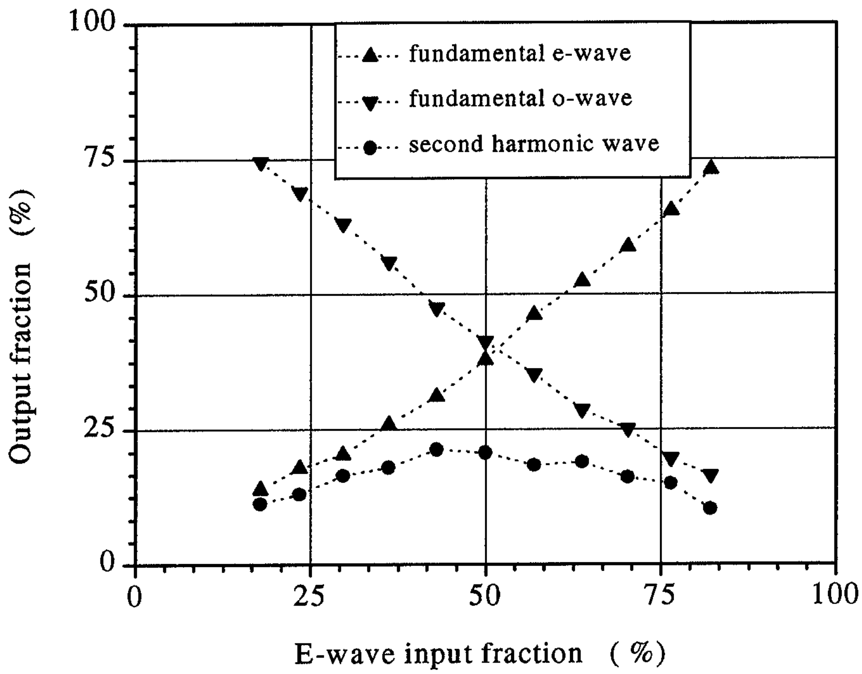
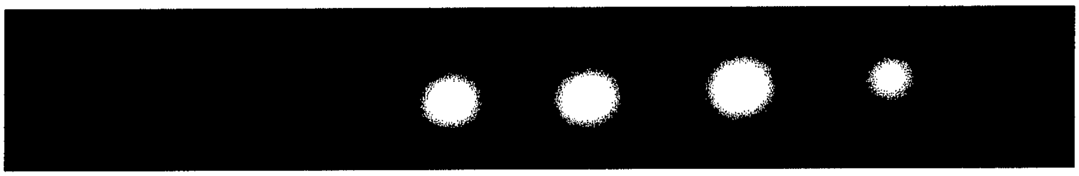


Fig. 4.1 The composition of the quadratic soliton generated for different vales of the fraction of the input beam in the extraordinary polarization for a Type II SHG interaction.

(b) An intriguing effect was reported previously in which the input intensity of the elliptical beam was high. The beam "broke up" into a line of cylindrically-shaped solitary waves as shown in Fig. 4.2. Up to 10 have now been observed. This effect has now been studied extensively and found to be a result of modulational instabilities in one dimension (along the major axis of the ellipse) of a beam in a quadratically nonlinear medium. Excellent agreement with a new theory was obtained. That beams break up in self-focusing media due to third order nonlinearities is well-known from the early days of nonlinear optics. This is the first observation of beam break-up in media used for SHG, tunable parametric generation devices (OPOs, OPGs etc.) and places limitations on such devices. In fact, it is highly likely that the beam filamentation and resulting damage observed in quadratically nonlinear media is due to cascading effects and not self-focusing due to third order nonlinearities. For very high intensities, break-up in the second dimension (along the minor ellipse axis) was also observed. *These phenomena can be used to better design high power devices in quadratic media and to generate soliton patterns in one and two dimensions.*

(a)



(b)

(c)

Figure 4.2 (a) Elliptically shaped input beam, (b) Low power input: spatial solitons at output of KTP crystal, (c) High power input: spatial solitons at output of KTP crystal

(c) Quadratic soliton formation during parametric down-conversion has been discovered and a fascinating device possibility uncovered. A pump beam (at 2ω) and a weak seed (at ω) have been observed to generate a quadratic soliton for Type II phase-matching. This corresponds to the degeneracy point of an OPO.

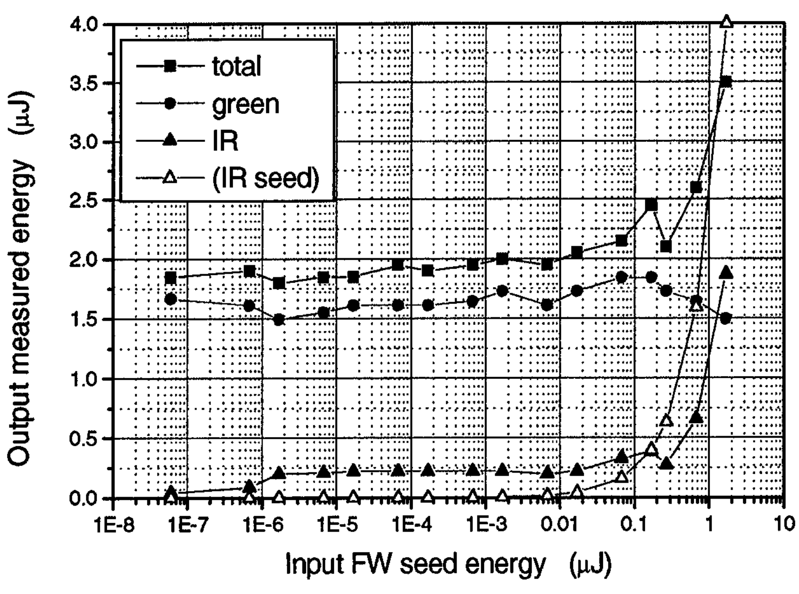
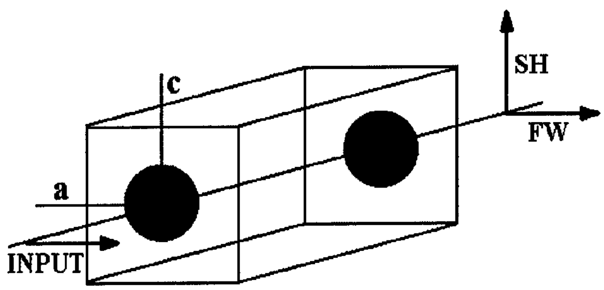


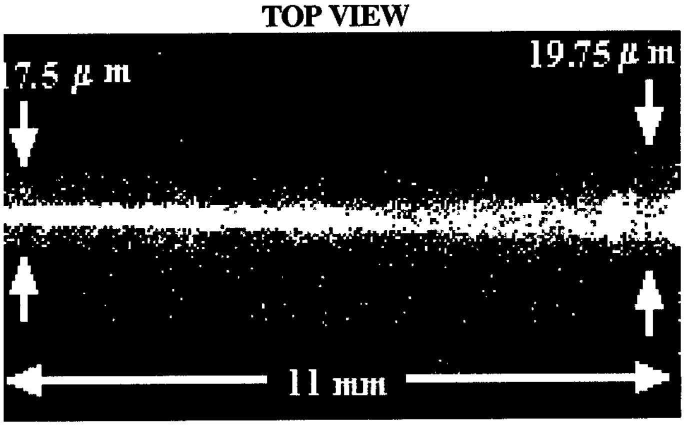
Figure 4.3 : Seed field (SF) energy impact on output fundamental and harmonic waves in our experimental conditions; pump field (PF) energy is 4 μJ, detuning $\Delta\beta L = -2\pi$.

Because of the well-known parametric instability, a photon from the pump beam breaks up into two fundamental photons via an exponential growth process. This process is controlled and limited by the formation of a quadratic soliton. For a given pump beam input, the output is clamped at a well-defined quadratic soliton, independent of *both the fundamental amplitude and polarization.* Furthermore, the process has been verified to be only weakly dependent on beam overlap in space and time, in keeping with the its "seed" nature. *This all-optical process provides up to 40 dB gain for the weak fundamental, and also clamps it's output at a fixed value (determined by the "power* supply", i.e. the harmonic intensity: These characteristics are that of a robust amplifier-limiter device.



d_{eff}=-12 pm/V λ_{PM}=985 nm for T=31.4 °C

TOP VIEW



5 Diffraction Lengths

$I_{threshold} < I_{985nm} = 36.4$ GW/cm^2

(d) We are now investigating quadratic solitons in $KNbO_3$. The $KNbO_3$ sample has sufficient impurities that we were actually able to image the soliton formation process (with a great deal of electronic image enhancement). It is shown on the left, along with the geometry for the non-critically phase-matched case. This case is especially interesting because at 985 nm this is Type 1 non-critically phase-matched, and because the effective nonlinearity > 15 pm/V. We have already found differences with the Type 2 case - namely the soliton composition is insensitive to the input pulse energy. Furthermore, the soliton threshold is well below 1 GW/cm^2.

(e) One dimensional quadratic solitary waves have been observed in $LiNbO_3$ slab waveguides based on Type I phase-matched SHG. When a fundamental beam (at 1320 nm) was launched into the slab waveguide, a 1D quadratic soliton was formed and appeared at the output. The solitons observed previously were far (phase-mismatch $\approx 10\pi$) from the phase-matching and the results were in excellent agreement with theory. This work has now been extended to near phase-matching wheree the second harmonic component is much larger (~40%), and again good agreement with theory was fond. *This should make possible most of the phenomena that we observed in the 2D case, but with* *much lower power requirements.*

Quadratic solitons were also investigated in slab waveguides. This corresponds to the one dimensional (1D) geometry. Birefringently phase-matched $LiNbO_3$ was used with laser excitation at 1.32μm which required heating to about 337°C for phase-matching at this wavelength. This geometry is appropriate for N ➔ N interconnects.

(f) The interaction between two 1D solitons launched in both a parallel and a crossing geometry has been investigated experimentally and numerically. The result of the interaction depends on the relative phase between the two launched fundamental beams. For parallel launching and phase angles of 0 and π, the solitons fuse and repel one another respectively. At π/2 and 3π/2, the beams exchange power before separating. For crossing geometries, the behaviour was essentially the same for small incidence angles. However at larger angles, no fusion occurs but the attractive and repulsive forces for phase angles of 0 and π lead to different lateral deflections of the output solitons, see Fig. 4.5. Furthermore the power exchange at other angles is reduced. *This phenomenon has applications to beam combining and sets limitations on soliton crossing angles for applications such as optical interconnects.*

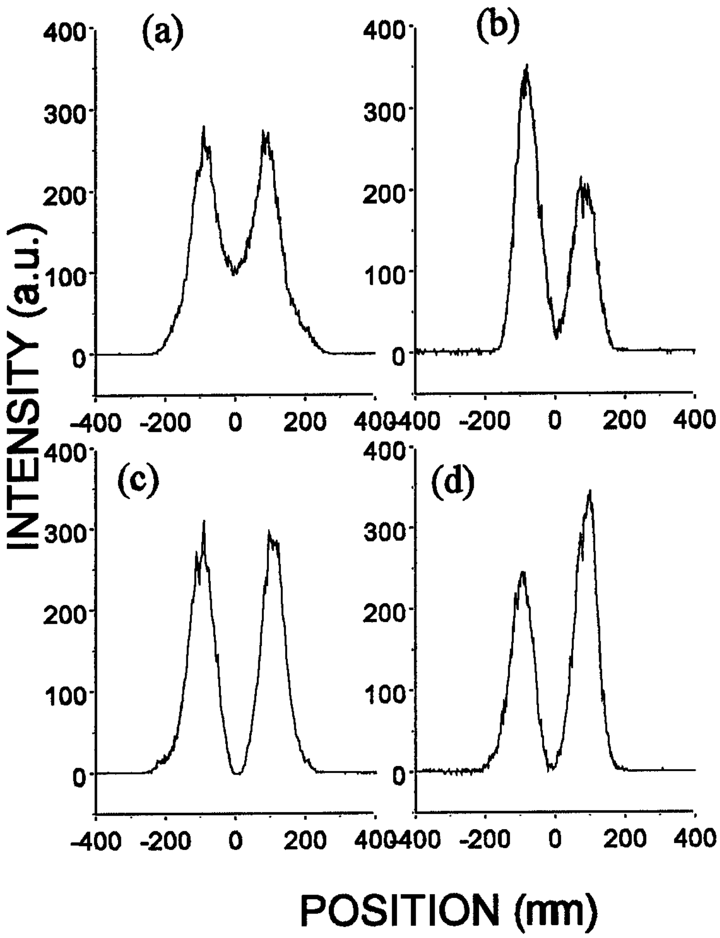
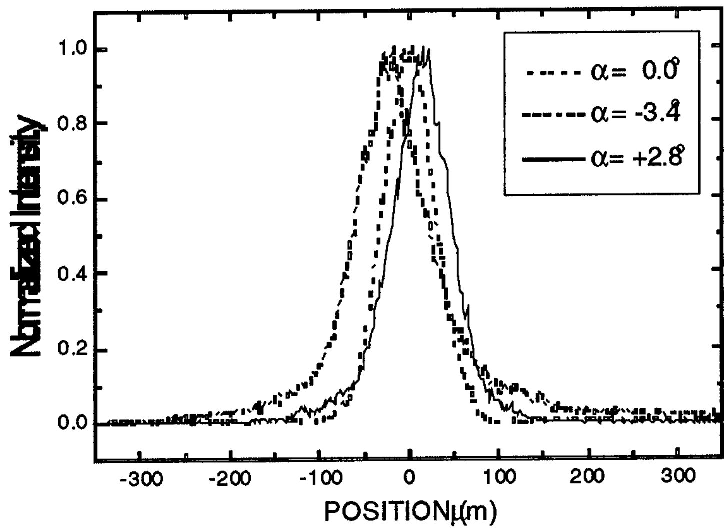


Figure 4.5 Measured output beam profiles for the two solitary wave interaction in the cross launching case for large net phase-mismatch (T = 335.05°C). The relative phase difference between the two beams is (a) 0, (b) π/2, (c) π and (d) 3π/2.

(g) It is known from previous work on KTP that under walk-off conditions the soliton propagates in a direction intermediate between that of the fundamental and harmonic. Then can the input power be used to perform "fine steering" of the solitons?

Steering of soliton propagation away from the optic-axis is shown in Figure 4.6, right side of page). (In this geometry, the orthogonally polarized fundamental and harmonic beams travel in slightly different directions.) The effects are clear, and it was obtained by operating just a few degrees away from the zero walk-off condition. When the incidence angle of the beam onto the input facet is varied at fixed input power, the propagation direction of the resulting soliton is not normal to the end face for two reasons.



(1) Deflection due to Snell's law - the usual effect.

(2) Steering due to the walk-off between the fundamental and harmonic components.

The results in the right side figure show the walk-off effect since the Snell's law deflection has been subtracted off. Clearly the walk-off effect can be controlled and utilized for fine-tuning beam deflections.

Conclusions:

The scientific questions addressed in the original proposal were essentially answered. We showed that:

1. Electrically reconfigurable interconnects based on signal guiding by spatials solitons works. A 1 ➔ 4 interconnect was demonstrated in AlGaAs slab waveguides at 1.5 μm. Further, more sophisticated demonstrations were curtailed by the premature termination of this grant.
2. An alternative material system with lower soliton powers, PTS, was investigated and solitons demonstrated in it.
3. Quadratic spatial solitons have many interesting properties, and in Type II media can be used for interconnects.

The principal disadvantage of this scheme is the high soliton powers required for the materials investigated. Practical implementation will require materials such as liquid crystals which have nanosecond response times, but also can generate solitons at sub-watt power levels.

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30. B. L. Lawrence, and George I. Stegeman, "Collisions of Two Dimensional Bright Spatial Solitary Waves at High Intensities in Polydiacetylene para-Toluene Sulfonate", Opt. Lett., 23:591-4 (1998)
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Invited Presentations:

"Family of Type II Quadratic Solitons and Their Applications", LEOS'98, Orlando, December 1998

"Multiphoton Absorption and Higher Order Nonlinearities in Polydiacetylenes: PTS", 8'th Iketani Conference, Hokkaido Japan, October 1998

"A Comparison of Second Harmonic Generation Utilizing Quadratic Spatial Solitons Versus Conventional Methods", (upgraded paper, given by M. Ohkawa), Annual OSA Meeting, Baltimore, October 1998

"Quadratic Solitons", Workshop on Solitons, Les Houches, September 1998

"Experiments on Bright Quadratic Solitons", Polish NLO conference, Miedzyzdroje Poland, September 1998

"Casacading: An Old Idea with New Twists", OPTEC conference on Optical Science and Laser Technology, Bozeman Montana, August 1998

"Experiments on Bright Quadratic Solitons", XVI International Conference on Coherent and Nonlinear Optics, Moscow, July 1998

"Bright Spatial Solitons", short course at XVI International Conference on Coherent and Nonlinear Optics, Moscow, July 1998

"Experiments on Bright Quadratic Solitons", European Commission COST P2 Workshop, Limerick Ireland, June 1998

"Bright Quadratic Solitons", ARO Workshop on Solitonic Gateless Computing, Rayleigh-Durham, May 1998

"Extended Family of Type II Quadratic Solitons Excited by Fundamental Waves of Unequal Energy", (given by R. Fuerst), IQEC'98, San Francisco, May 1998

"Beam Instabilities in Quadratic Media", IEEE LEOS Annual Meeting, San Francisco, November, 1997

"Multiphoton Absorption in Conjugated Polymers: PTS", Air Force Workshop on Multiphoton Absorption and its Applications, Dayton, October 1997

"Progress in Quadratic Solitons", Annual OSA Meeting, October 1997

"Experiments with Quadratic Solitons", 3 lectures, NATO Summer School on $\chi^{(2)}$, Sozopol (Bulgaria), September 1997

"Second and Third Order Nonlinear Optics in Semiconductors and Polymers: Second Harmonic and Soliton Generation", Symposium of the Center of Excellence in "Physics and Chemistry of Optical Films", Jena, August 1997

"Cascaded Nonlinear Optics", Gordon Conference on Nonlinear Optics, Tilton Academy, July, 1997

"Experimental Demonstrations of Spatial Solitons", KAIST, Taejon Korea, July 1997

"Cascaded Nonlinear Optics", Pusan National University, Pusan Korea, July 1997

"Experimental Realizations of Spatial Solitons", Summer School on Solitons : Concepts And Recent Developments, Université de Bourgogne, Dijon, France; ESERG-LEMO University of Grenoble, Grenoble, France; Laboratoire d'Optique des Surfaces et des Couches Minces, University of Marseilles, Marseilles, France, June 1997

"Three-wave simultons:quasi particles in quadratic media", (given by G. Assanto), Italian Summer School, Cetaro Italy, June 1997

"Spatial Soliton Robustness against spatially anisotropic phase perturbations", (upgrade given by J.U. Kang), QELS'97, Baltimore, May 1997

"Spatial Solitons in Bulk PTS", Trinity College, Dublin, Ireland, April 1997

"Nonlinear Optical Materials and the Experimental Realization of Spatial Solitons", Photonics Workshop, Guadelajara Mexico, January 1997

"Cascading Nonlinear Optics", seminar, Bell Labs, November 1996

"Applications of Cascading Nonlinear Optics", Annual LEOS'96 Meeting, Boston, November 1996

"Spatial Solitary Waves using Second Order Nonlinearities", (given by B. Lawrence), Annual LEOS'96 Meeting, Boston, November 1996

"Cascading Spatial Soliton Phenomena", (given by Torruellas) Annual ILS/OSA Meeting, Rochester NY, October 20-25 1996

"Nonlinear Optical Materials and the Experimental Realization of Spatial Solitons", Workshop on Nonlinear Optical Phenomena and Applications, Kaziemerz Poland, September 1996

"Cascaded Second-Order Nonlinearities", (given by R. Schiek), URSI XXVth General Assembly, Lille, France, August 1996

"Observation of Manakov spatial solitons in AlGaAs planar waveguides", upgraded invited, IQEC'96, Sydney, Australia, July 1996

"Experimental Progress in Cascading Nonlinear Optics", Nonlinear Optics: Phenomena and Applications, Maui, July 1996

Contributed Conference Papers:

1 "Stable Self-Trapping in Polydiacetylene para-Toluene Sulfonate" (given by B.L. Lawrence) Proceedings of the American Chemical Society Division of Polymeric Materials: Science and Engineering, Orlando, FL, p. 169, Fall Meeting 1996.

2. "Light Trapping in Quasi-Phase-Matched Second-Harmonic Generation" (given by L. Torner) Nonlinear Guided Waves and Their Applications, Cambridge, England, 1996 Technical Digest Series Volume 15, p. 65, August 30 - September 1, 1996.

3. "Mixed-mode spatial solitons in semiconductor waveguides with cubic anisotropy" (given by N.N. Akhmediev) Nonlinear Guided Waves and Their Applications, Cambridge, England, 1996 Technical Digest Series Volume 15, p. 94, August 30 - September 1, 1996.

4. "Nonlinear Multi-Core Directional Couplers in AlGaAs" (given by P. Millar) Nonlinear Guided Waves and Their Applications, Cambridge, England, 1996 Technical Digest Series Volume 15, p. 125, August 30 - September 1, 1996.

5. "All-optical steering of spatial solitary-waves through cascading in KTP" (G. Assanto) Nonlinear Guided Waves and Their Applications, Cambridge, England, 1996 Technical Digest Series Volume 15, p. 151, August 30 - September 1, 1996.

6. "Vector spatial solitons" (given by J.S. Aitchison) Nonlinear Guided Waves and Their

Applications, Cambridge, England, 1996 Technical Digest Series Volume 15, p. 266, August 30 - September 1, 1996.

7. "Solitary waves and ring-formation in polydiacetylene para-toluene sulfonate" (given by G. I. Stegeman) Nonlinear Guided Waves and Their Applications, Cambridge, England, 1996 Technical Digest Series Volume 15, p. 272, August 30 - September 1, 1996.

8. "Solitary waves and ring-formation in polydiacetylene para-toluene sulfonate" (given by B.L. Lawrence) Proceedings of the Third International Conference on Organic Nonlinear Optics, Marco Island, FL, p. 90, December 16-20, 1996.

9. "Modulational instability of a strip input beam and multisoliton generation in a bulk quadratic equation", (given D.-M. Baboiu) by Proceedings QELS'97, p. 151, Baltimore, MA, May 18-23, 1997.

10. "Interaction of one-dimensional quadratic solitons in lithium niobate planar waveguides", (given Y. Baek) by Proceedings QELS'97, p. 151, Baltimore, MA, May 18-23, 1997.

11. "Spatial soliton robustness against spatially anisotropic phase perturbations"(given by J.Y. Kang, upgraded to invited), Proceedings QELS'97, p. 151, Baltimore, MA, May 18-23, 1997.

12. "Large phase shifts resulting from the $\chi^{(2)}$ cascading nonlinearity in large walk-off regimes in semiconductors and other dispersive materials"(given by Y. Ueno) Proceedings QELS'97, p. 153, Baltimore, MA, May 18-23, 1997.

13. "Generation of two-dimentional spatial soliton patterns by laser modes in a quadratic medium", (given by P. Agin) Proceedings QELS'97, p. 153, Baltimore, MA, May 18-23, 1997.

14. "Observation of modulational instability in a quadratically nonlinear optical medium in one and two dimensions", (given by R.A. Fuerst) Proceedings QELS'97, p. 155, Baltimore, MA, May 18-23, 1997.

15. "Dynamics of mixed mode spatial solitary waves in AlGaAs waveguides", (given by J.U. Kang) Proceedings QELS'97, p. 101, Baltimore, MA, May 18-23, 1997.

16. "Four Photon Absorption in the Single Crystal Polymer PTS", (given by G.I. Stegeman, postdeadline paper), OSA/ACS Joint Topical Meeting on Organic Thin Films for Photonics Applications, Long Beach, October 1997

17. "One dimensional quadratic walking solitons in lithium niobate planar waveguides", (given by Y. Baek), OSA Topical Meeting on Nonlinear Guided Wave Phenomena, Victoria Canada, April 1998, NWB3

18. "Quadratic spatial soliton generation by seeded down conversion of a strong pump beam", (given by R., Fuerst), Proceedings IQEC'98, San Francisco CA, May 3-8 1998, QME2

19. "Three- and four-photon absorption in the single crystal polymer PTS", (given by Hoon Shim), Proceedings CLEO'98, San Francisco CA, May 3-8 1998, QTuC5.

20. "Fabrication of single crystal PTS channel waveguides", (given by M. Liu), Proceedings C:EO'98, San Francisco CA, May 3-8 1998, CWA2

21. "Dynamic soliton steering in AlGaAs waveguides for reconfigurable optical interconnects" (given by L. Friedrich), LEOS'98, Orlando FL, December (1998), paper ThO5

22. "Observation of two-dimensional quadratic spatial solitons in type I potassium niobate", (given by R. Fuerst), LEOS'98, Orlando FL, December (1998)

23. "Dynamic, electronically controlled, angle steering of spatial solitons in AlGaAs waveguides for reconfigurable interconnects" (given by L. Friedrich), Annual OSA Meeting, Baltimore MA, October 5-9 (1998)

24. “Dynamic soliton steering in AlGaAs waveguides for reconfigurable optical interconnects” (given by L. Friedrich), LEOS’98, Orlando FL, December (1998), paper ThO5

25. “Observation of two-dimensional quadratic spatial solitons in type I potassium niobate”, (given by R. Mandelevich), LEOS’98, Orlando FL, December (1998)